Direct Machine and Control

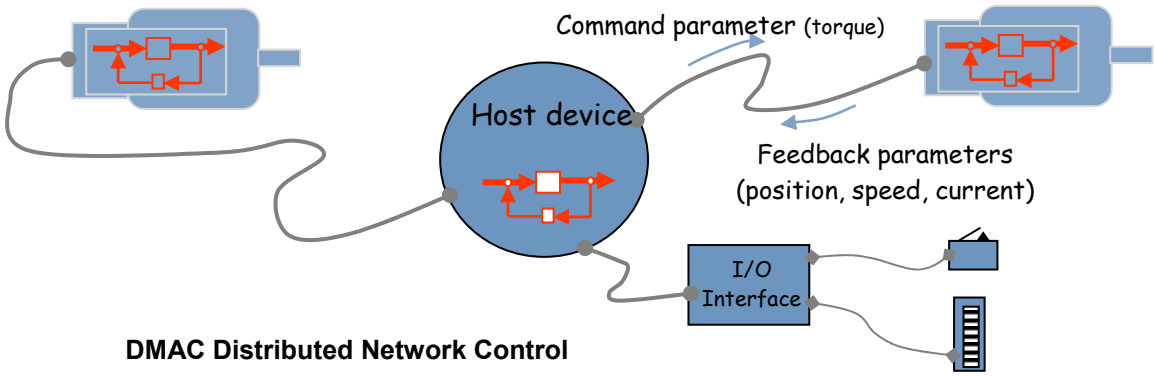
BRIGHAM YOUNG UNIVERSITY

CENTER

The center is developing a software-based digital control architecture configured on a host computing device to control, in real-time, a distributed high speed network of motors, sensors and other I/O devices. The primary control loops are closed over the high speed network. Only the torque/current loops are closed at the motor using digital power electronics. Although the primary focus is software development, some supporting hardware has been developed and/or configured to support the control network, including dual CPU control processors, machine tool enabled Coordinate Measurement wireless hardware, and Ethernet enabled sensor boards and motor control boards. The advantage of this new distributed approach to control is reduced control hardware, control of distributed rather than collected devices, reduced control costs, and greater control flexibility through modern control methods that cannot be enabled under the restrictions of modern controllers. DMAC is currently working on other technologies in relation to the DMAC technology.

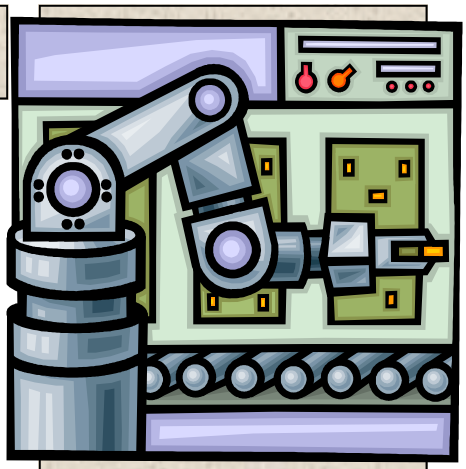
TECHNOLOGY

The DMAC technology is based on the development of an open architecture controller and supporting control algorithms for general control of advanced mechanisms such as 5-axis machine tools. This controller uses a dual CPU PC/controller so that the CAD/CAM application can run under Windows, while the real-time control software can run under a second CPU. The motors and machine Input/Output (I/O) are commanded over a high speed network such as fiber optic and IEEE 1394 (firewire). The control software consists of object oriented libraries that integrate motion planning, trajectory generation, servo-control, communication, and user interfaces. In addition, new control methods are being developed such as curvature matched machining (CM2), and higher dimensional methods of representing and passing geometric tool path data between the CAD/CAM application and the DMAC controller. The center has also been used to investigate and evaluate current process planning applications for industry.



DMAC Distributed Network Control

DMAC



ACCOMPLISHMENTS

In the first year of funding DMAC has accomplished several milestones which includes the following: the DMAC motion control library near commercial grade; new NURBS look-ahead algorithms for motion planning; control across both fiber optic and IEEE 1394 networks; DMAC control retrofit of the GM donated 5-axis Taurus mill underway; the Proof-of-concept for direct process planning in Alias/Waveform geometric modeling application and work performed for General Motors; Proof-of-concept for using N-dimensional NURBS to pass advanced tool paths to the DMAC controller. Continued support of Direct Controls, Inc. in commercialization of DMAC controller. Developed API control interface library jointly with Wilcox for direct control of CMM process by PC-DMIS application which is now in testing phase; developed VMAC control architecture for variable frequency control of different devices; developed new VMAC I/O and control board hardware that uses 802.3 communication standards, modified for real-time control using a *speak when only spoken to* protocol; developed new user XML user interface methods for control of the distributed VMAC devices. We have used grant money from Ford to compare/evaluate 5-axis tool path planning among the more popular commercial CAM application software packages. Grants have been obtained from Wilcox of wireless CMM hardware and PC-DMIS software and installed on Sugino 3-axis mill. Communications have been established between application and hardware.

THINK TANK

What if there was...

A way to control, in real-time, a high speed network of motors sensors and other devised with a software-based digital control computing device???

Ed Red
BYU
435 R CTB
Provo, UT 84602
801-422-5539
ered@et.byu.edu